panion in the matter of liberating an unusual amount of energy in a certain part of the orbit, most likely a small fraction of the period after periastron passage. Dr. CAMPBELL has called my attention to the fact that the *Algol* variables, which are binaries of even shorter average period than the *δ Cephei* variables, show no evidence of light-variation other than that caused by eclipse, and that the apparent failure of two *Algol* components to disturb each other should make us careful in ascribing the total observed effects in *δ Cephei* variables to the mutual disturbing powers of the components. Most of the eclipse variables have earlier-type spectra (*B, A,* and *F*) than the variables of Class IV. It is not impossible that in close binary pairs having the simpler types of spectra (*Algol* variables) the mutual disturbances are less effective in producing brightness-variations than in close pairs having older types of spectra (*δ Cephei* variables). S. ALBRECHT.

ON THE DISTORTIONS OF PHOTOGRAPHIC FILMS ON GLASS.[1]

Introduction.

In various lines of astronomical research depending upon photographic plates, discrepancies of a considerable magnitude occasionally appeared, which seemed attributable to no definite cause. On the star-photographs taken with the Crossley reflector these occasional discrepancies, which seemed to be more or less accidental, usually amounted to a few tenths of a second of arc, and very rarely to as much as a second of arc, which is equivalent to a linear distance of about 0.001 inch (0.02^{mm}). Even though discrepancies are the exception rather than the rule, and discrepancies of the magnitude referred to above are extremely rare, nevertheless they cause considerable annoyance when extreme accuracy is desired, for the error of measurement need not much exceed 0.001^{mm}. It seems highly desirable definitely to locate, if possible, the cause of the difficulty. In the case of the Crossley star-photographs it seemed for a time as though the cause must be sought for in the large mirror of the telescope. Another alternative was the study of the photographic film itself. Accordingly, in the winter of 1904,

[1] Thesis in partial fulfilment of the requirements for the degree of doctor of philosophy in the University of California. A more complete account is published in *L. O. Bulletin,* No. 118, and in the *Astrophysical Journal,* Vol. XXV, 349, 1907.

at the suggestion of Director CAMPBELL and Dr. PERRINE, the writer undertook an investigation of the distortions of the gelatine film.

The more important features of the plan upon which my work was begun were investigations of the effects of (*a*) the position of the plate during the processes of washing and drying, (*b*) the rate of drying, (*c*) abrupt changes in the rate of drying during the process, (*d*) change in the position of the plate while drying, (*e*) hardener. Emulsions on plate-glass were also tried. JEWELL'S developer was used, and the plates were 3¼ x 4¼ inches (83 x 108^{mm}) in size, the same as are used with the Crossley reflector.

Summary of Results.

1. For the size of the plates used (3¼ x 4¼ inches) it was found to be entirely indifferent whether the plate be vertical or horizontal during development, fixing, washing, and drying.

2. Within the range of the observations, hardener, the rate of drying, and changes in the rate of drying and in the position of the plate during the process of drying introduced no general distortions of the gelatine film.

3. Local distortions were found on artificial-star plates and on spectrograms. These distortions were confined in each case to an area equal to a small fraction of a square millimeter. The largest lateral displacement found at any point in the distorted area was 0.02^{mm}, while the great majority were less than one fourth of this amount. Some of these displacements are several times as large as the errors of measurement, and their possible effects must be taken into account where great accuracy is desired.

4. These distortions seem to be principally of two different kinds: one was due to an actual movement of a minute portion of the film, the other was an apparent shift of the image due to the peculiar arrangement of the silver grains or to local differences in the sensitiveness of the film.

5. The results obtained from one plate-glass plate showed no advantages of the plate-glass over the ordinary commercial plates in the matter of distortions of the film.

6. If the results obtained in this investigation for small plates be found to apply with equal force to larger plates, it will follow that the assumption which is the basis for the use of

the réseau is not well founded. The assumptions involved, briefly stated, are as follows: First, general distortions exist; second, they differ in different parts of the plate; third, they may be assumed to be linear within the squares of the reseau (i. e. over a stretch of 5^{mm} or more). The supposed advantages of the reseau over the method of referring all the measures to a common center rest entirely upon the validity of these three assumptions. If the reseau can be dispensed with there will be a saving of the labor involved in making the large number of settings on the reseau-lines and in the reductions of the measurements.

S. ALBRECHT.

LICK OBSERVATORY, UNIVERSITY OF CALIFORNIA,
May, 1907.

NEW DOUBLE-STAR DISCOVERIES.

Since the publication of the list of two hundred and fifty new double stars in *Lick Observatory Bulletin,* No. 109, more than one hundred additional pairs have been discovered with the 36-inch and 12-inch telescopes of this observatory. Included in this number are the following, which seem worthy of special note:—

29 *Hydræ* = β 590. The 36-inch shows that the principal star is a close double. My measures are:—

1907.21	182°.8	0″.17	7.2–7.2	2^n	*A* and *B*.
1907.21	175 .4	10 .79	6.7–12.5	2	*A B* and *C* = β 590.

According to BURNHAM, the principal star has an annual proper motion of 0″.068 in 268°.3. It is clear that this is common to both components, for otherwise the close pair would have been detected by BURNHAM when he discovered the faint star. Measures of *C* show no relative change, hence this star, too, belongs to the system.

B. D. + 46°.2054 = Es. 75. The southern star of ESPIN's pair is a neat double. My measures give:—

1907.40	275°.7	0″.63	9.7–9.8	3^n	*A* and *B*.
1907.39	35 .6	4 .39	9.2–9.3	2	*A B* and *C* = ESPIN 75.

In *Astronomische Nachrichten,* No. 3784, ESPIN gives the position for 1880 as $12^h\ 15^m.9$; + 46° 29′, and this is copied by BURNHAM in his general catalogue. It should be $15^h\ 15^m.9$; + 46° 29′.

53 (μ^2) *Boötis.* The 36-inch telescope shows that this naked-eye star is an exceedingly close double. Measures on